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1.	Your reference	BAILLIE/LED
2.	Patent application number *(The Patent Office will fill in this part)*	**9704423.4** 04 MAR 1997
3.	Full name, address and postcode of the or of each applicant *(underline all surnames)*	William John Baillie-Hamilton 6 Prestwood Terrace Downshire Way Bracknell Berks RG42 1XU
	Patents ADP number *(if you know it)*	6979595001
	If the applicant is a corporate body, give the country/state of its incorporation	–
4.	Title of the invention	'Light Emitting Device and Arrays Thereof'
5.	Name of your agent *(if you have one)* "Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	Olaf C Rock Rock and Company Trelawn Cassington Witney Oxford OX8 1Dn 3060766003
	Patents ADP number *(if you know it)*	~~691220001~~

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		UK	96 08381.1	23/ 04/ 96

7.	If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application	Date of filing *(day / month / year)*
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8.	Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:* *a) any applicant named in part 3 is not an inventor, or* *b) there is an inventor who is not named as an applicant, or* *c) any named applicant is a corporate body.* *See note (d))*	no

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Continuation sheets of this form	
Description	~~17~~ 18
Claim*(s)*	5
Abstract	1
Drawing*(s)*	4

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Priority documents	no
Translations of priority documents	no
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	no
Request for preliminary examination and search *(Patents Form 9/77)*	yes
Request for substantive examination *(Patents Form 10/77)*	yes
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature Date 4/3/97

12. Name and daytime telephone number of person to contact in the United Kingdom Olaf C Rock 01865 880389

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LIGHT EMITTING DEVICE AND ARRAYS THEREOF

This invention relates to a light emitting device and arrays thereof. The term 'light' is used in this context to include any form of electromagnetic energy where a need exists to generate it at one location for transmission and utilisation at a further location

Light conducting elements, for example fibre optics, are a well known means of conducting light from a remote source to a desired destination. State of the art fibre optic cables allow relatively large amounts of energy to be transported through relatively small fibres that are flexible, strong, and water resistant. However inputting light energy into relatively small fibres from existing light sources can be expensive as the light sources were not necessarily originally designed for this purpose.

Most light emitting devices consist of an element for emitting light such as a filament surrounded by a vacuum or a gas or gas mixture or an arc contained in a transparent housing. Alternative types of light emitting device are a light emitting diode surrounded by a solid transparent material. Light emitted from the source radiates outward and can be reflected or concentrated by external mirrors and/or lenses in the correct direction and at the required concentration. However suitable lenses and/or mirrors have to be accurately manufactured and are relatively expensive. In use they tend to absorb the energy that is being produced. Due to manufacturing limitations the lens and/or mirror can fail to be an optimised configuration to refract/reflect the light from the source. When otherwise appropriately manufactured by existing techniques such mirrors and/or lenses fail to control the light sufficiently.

Light conducting fibres have a limited acceptance angle which means that unless the directed light is presented to the conducting element at the maximum angle or less the light is not conducted. Also every occurrence of reflection and/or lens transmission can absorb or scatter between 10 and 30% of the original light. If we add to these losses from absorbtion and transmission Further losses can be added to those of absorbtion and transmission including: those from reflector shape and size;

from surface input into the fibre; and through the bulb containment housing. When all these losses are added together there is left a relatively small balance from the transmitted original light.

In order to overcome such losses many current designs utilise brighter and larger light sources. This comes at a price because apart from light such sources produce large amounts of heat which combined with bad directional control can lead to overheating of the bulb and the light conducting fibres. This leads to a requirement for an external fan or other cooling device which adds cost and bulk and an overall increase in energy required by the whole process.

These factors all limit the commercial applications for light conducting elements as the commercial cost outweighs the usefulness of the product. Alternatively the size of the device and/or its energy requirements exceed those of components available to product designers.

According to a first aspect of the present invention there is provided a light outputting device comprising:

a containment for housing an element for emitting light;

a light conducting element aligned relative to the containment by means of the containment or an extension thereof the light conducting element having a light input region such as an end face of the light conducting element; and

a light output region of the containment adapted for alignment with the light conducting element so that light generated by the emitting element is caused to pass by way of the light output region into the light input region.

According to a first preferred version of the first aspect of the present invention the containment or an extension thereof serves to locate the light output region of the containment relative to the light input region of the conducting element such that the light input region is closer to the element for emitting light than the major part of the containment.

According to a second preferred version of the first aspect of the present invention or the first preferred version thereof the containment serves to provide a location means

for the device adapted for complementary engagement with an external device whereby the device can be demountably attached by means of the light conducting element or an extension thereof to a further light conducting path in a predetermined position relative to some path datum.

According to a third preferred version of the first aspect of the present invention or any preceding preferred version thereof there is provided a reflector located relative to the element for emitting light and the, or at least one, light conducting element so as to reflect light from the element for emitting light by way of the light output region into the light input region of the light conducting element.

According to a fourth preferred version of the first aspect of the present invention or any preceding preferred version thereof there is provided a refractor located relative to the element for emitting light and the, or at least one, light conducting element so as to refract light from the element for emitting light into the light input region of the conducting element.

According to a fifth preferred version of the first aspect of the present invention or any preceding preferred version thereof the containment is substantially opaque except for the light output region and light can only pass out of the containment by way of the light output region to the, or at least one, light conducting element.

According to a sixth preferred version of the first aspect of the present invention or any preceding preferred version thereof the device incorporates heat transfer means such as a heat sink in intimate contact with, or forming an integral part of, the containment whereby heat generated by the element for emitting light can be dissipated.

According to a seventh preferred version of the first aspect of the present invention or any preceding preferred version thereof the device incorporates heat transfer means such as a heat sink in intimate contact with, or forming an integral part of the, or at least one, light conducting element whereby heat generated by the element for emitting light can be dissipated.

According to an eighth preferred version of the first aspect of the present invention or any preceding preferred version thereof the containment serves to define a plenum about the element for emitting light so as to maintain in the plenum a vacuum about the element for emitting light.

According to a ninth preferred version of the first aspect of the present invention or the first to the seventh preceding preferred versions thereof the containment serves to define a plenum about the element for emitting light so as to maintain in the plenum an inert gas or a mixture of gases about the element for emitting light.

According to a second aspect of the present invention there is provided a method of fabricating a light outputting device according to the first aspect or any preferred version thereof characterised by the steps of:

providing the light conducting element in the form of a longitudinal member with end faces and an outer surface apart from the end faces;

locating around the light conducting element a sleeve member of greater length than the light conducting element with a first end of the light conducting element at or near one end of the sleeve so as to leave a length of sleeve projecting beyond the opposite end of the light conducting element to the first end;

the opposite end of the light conducting element to the first end forming, at least in part, the light input region;

causing the sleeve member to be contiguously juxtaposed with the outer surface of the light conducting element;

locating the element for emitting light in the length of sleeve projecting beyond the opposite end;

deforming the length of sleeve so as to form together with the light input region of the light conducting element the containment for the element for emitting light; and

sealing the deformed length of tube to cause the containment to form a gas tight enclosure for the element for emitting light.

According to a first preferred version of the second aspect of the present invention the sleeve is of a similar material to the light conducting member and the step of causing the sleeve member to be contiguously juxtaposed with the outer surface of

the light conducting element comprises a fusing operation.

According to a second preferred version of the second aspect of the present invention the sleeve is of a translucent or opaque material having a thermal coefficient of expansion comparable with that of the light conducting member.

According to a third preferred version of the second aspect of the present invention the step of locating the element for emitting light in the length of sleeve projecting beyond the opposite end includes locating conductors for supplying energy to the element.

According to a fourth preferred version of the second aspect of the present invention the step of locating the element for emitting light in the length of sleeve projecting beyond the opposite end includes locating a mirror element relative to the element for emitting light to enable the mirror element to be enclosed with the element for emitting light prior to the deforming and sealing steps.

According to a fifth preferred version of the second aspect of the present invention the step of locating the element for emitting light in the length of sleeve projecting beyond the opposite end includes locating a lens element for refracting light generated by the element for emitting light to enable the lens element to be enclosed with the element for emitting light prior to the deforming and sealing steps.

According to a third aspect of the present invention there is provided an array comprising at least two devices according to the first aspect or any preferred version thereof or manufactured by way of the second aspect and a light guide array linking the or at least one light conducting element from each device to a light output location remote from at least one device.

According to a first preferred version of the third aspect of the present invention at least one of the devices is coupled to a heat exchange means whereby heat generated by the or each device is dissipated such as by natural or forced convection utilising gas or liquid coolant.

According to a second preferred version of the third aspect of the present invention or the first preferred version thereof there is incorporated in the light guide array or the light output location means for varying the colour of light originating from at least one of the devices.

According to a third preferred version of the third aspect of the present invention at least one of the devices of the array is demountably attached to the array and a magazine of replacement devices is located for the demountably attached device to enable the demountably attached device to be readily removed and replaced by a replacement device from the magazine thereof.

An object of this invention is to collect light close to the source such as a filament, laser or semi-conducting light emitting device where the light energy is at its most concentrated. This saves on a requirement for larger and or complex external lenses and mirrors. The light is positioned close to, and is fed directly into, a light guide, so saving energy losses which arise from the use of: reflectors, lenses, and containment housings. As the device can use any simple or complex state of the art system it can be mass produced.

Even where direct connection is not required the light energy is output in a very concentrated form which allows smaller light guides to be connected to the devices output. This contrasts with larger light guides required with presently existing systems uitilising less efficient light generation and conducting systems.

Where very large amounts of energy are required, existing devices are limited by overheating of the separate components. The present invention enables a cooling system to be readily employed. If required excess heat energy can be made use of.

The present invention also provides for devices of greater strength than heretofore to improve longevity. Typically these can be used in vehicles where, for example, the device can be linked to a vehicle cooling system. The invention also provides for devices to be much more efficient so in many cases avoiding the need for a cooling systems which is required in current applications.

The combined emission and collection device, surrounds an element for light emission such as a filament or arc, or a laser or light emitting semi conductor device, by one or more light conducting elements, that are slightly spaced from the element, arc, etc. or in the case of solid state lights, i.e. light emitting diodes, the light conducting element is inserted into a solid body. In all cases the light conducting element, is designed to carry light from the source of the bulb, or device, to the edge of its case, through vacuum or gas, liquid or solid. The light conducting element can stop at or on the inside of the case, or continue through the outer case. which is still sealed or solid, to a distance that is directly to the required output of the light, or to a distance and shape, that is suitable for the easy connection of flexible or other light guides, or light conducting devices.

The number of these internal light conducting elements can be reduced by internal mirrors and or lenses, and their collection or function, enhanced by the use of state of the art materials, solids or coatings. The covering of the bulb, solid or coatings may no longer all be required, for the transferral of light, and therefore can now be constructed by moulding, from a non transparent state of the art material, for example a metal, that would allow the total device to be stronger quite apart from enabling the provision of any other desired property. A gas or liquid, or case can be used to circulate a gas, or liquid, to collect heat energy for cooling or energy maximisation, thorough for example a heat exchanger, which can be incorporated as part of the device.

A fluorescent material can be used inconjucntion with, or incorporated in, a device according to the present invention so that on being excited by light emission from the light emitting element the material fluoresces to generate a distinctive optical effect.

The devices of the invention lend themselves to a wide range of applications some of which will be exemplified or referred to later. Usage of the invention in a communication context is particularly appropriate in view of the efficient usage of light and the possiblity of miniaturisation made available by the present invention.

Exemplary embodiments of the invention will now be described with reference to the accompanying drawings of light emitting and channelling devices in which:

Figure 1 shows a side view of a first embodiment;
Figure 2 shows a top view of a second embodiment;
Figure 3 shows a side view of a third embodiment;
Figure 4 shows from a top view a section through a fourth embodiment;
Figure 5 shows a side sectional view of the device of Figure 4;
Figure 6 shows a side view of a fifth embodiment;
Figure 7 shows a side view of a sixth embodiment; and
Figure 8 shows manufacture of a seventh embodiment.

FIGURE 1

Device 10 comprises of a light emitting element 11 housed in a containment 14 in this case of glass which serves to retain a vacuum in plenum 12 around light emitting element 11. Conducting elements 13 extend towards element 11 and serve to capture most of the energy emitted by the element 11. This energy is guided out of the device to the end of the light conducting element 13 outside the containment 14 where the light energy can be used directly, or by way of a light emission system utilising fibre optic cable for onward transmission. Each light conducting element 13 is solid and is sealed to the containment 14 at region 16, to ensure the required vacuum is maintained in the containment 14. Each conducting element 13 has an end face E set square, and close to, emitting element 11 to provide for efficient light transfer from emitting element 11 into each conducting element 13.

The containment 14 is mounted on a base 17 by means of which the device 10 is connected to a power supply. In this case the bases 17 comprises two main parts 17A, 17B that are electrically insulated from each other by insulator 18 to provide a means of connecting the element 11 to a supply of electricity. The base 17 is formed with a screw thread 19 enabling the device 10 to be secured to a conventional socket.

FIGURE 2

Device 20 is similar in many respects to that described above in relation to Figure 1. However in this embodiment light emitting element 21 is located in a plenum 22 having a gas filling rather than a vacuum. Containment 24 is made from quartz glass

and serves to locate conducting elements 23 with their end faces E close to and square with the emitting element 21 to provide for effective light transfer into each conducting element 23.. Base 27 provides for the accurate location of the of the device

FIGURE 3

Device 30 is constructed as described above in relation to Figure 1 saving that in this embodiment only one light conducting element 33 is located with its end face E on one side of light emitting element 31. Light from the other side of the emitting element 31 is reflected back into end face E of the conducting element 33 by a shaped and coated reflector 38. Base 37 functions in an identical manner to that of base 17 referred to in the description of Figure 1.

FIGURES 4 AND 5

Device 40 has a light emitting element 41 surrounded by four conducting elements 43A to D. The conducting elements 43A to D pass through the wall of containment 44 by ways of seals, typically seal S for element 43B. End faces E of each conducting element within the containment are set squarely towards the emitting element 41. As a high power device 40 containment housing 44 is made from a state of the art ceramic material which is heat conducting and extremely strong. The containment has cooling fins 49. Plenum 42 serves to retain a gas filling. The light emitting element 41 is coupled by conductors C1, C2 of substantial cross section.

FIGURE 6

Device 60 has a light emitting element 61 is provided with a back reflector 68 which emits a narrow beam of light energy which is in turn collected by end face E of light conducting element 63 and so transmitted through containment 64 to output 65. Conducting terminals 67A, 67B provide electrical power to the light emitting element 61 and the containment 64, in this case of plastics material, supports the terminals 67A, 67B in relation to each other.

FIGURE 7

This embodiment is a device 70 similar to that described in relation to Figure 6 saving that light emitting element 71 is inserted directly into a light conducting

element 73 to contact end face E of the conducting element 73. In this case containment 74 forms a part of light conducting element 73 which is of plastics material. The light emitting element 71 can be any state of the art electromagnetic energy emitting material and can be customised to match the light conducting element 73 or elements. The design of the whole device 70 is adapted to minimise any interference with the output of the electro magnetic energy while enhancing its functional efficiency.

The light conducting element 73 is of quartz glass where necessary coated or multi coated or enhanced by a light modifying coating. The light conducting element 73 can itself be made by one or more smaller coated elements fused together. These elements 73 can be manufactured from any state of the art material or process with coatings as above or process that can enhance transmission function of desired electro magnetic energy wave lengths.

The shape of these light conducting element 73 is matched in number, size and shape to maximise the collection of electromagnetic energy from the light emitting element 71. Preferably these light conducting elements 73 are solid, composite or hollow or liquid or any combination of these or other state of the art light guiding systems. The elements can be curved, flexible, sheathed, straight, coiled, amorphous, or have any property or shape that enhances its function. lenses or other state of the art light modifiers. Reflectors corresponding to those shown in Figures 3, 6 or 7 may be of any material or shape and can be used in or on any internal or external part of the device and be coated or treated with any state of the art coating or enhancement method.

FIGURE 8

This shows the fabrication of a light emitting device.

Figure 8A shows a sleeve 81 of quartz glass with flame polished ends 82, 83. The sleeve is of length L1 and internal bore B

Figure 8B shows a light conducting element in the form of a quartz glass rod 84 of length L2 and external diameter D with square cut ends 85, 86.

Figure 8C shows the sleeve 81 positioned around rod 84 with end 82 of sleeve 81 aligned with ends 85 of rod 84. As the length L1 of the sleeve is considerably greater than rod 84 the sleeve extends over a further distance X beyond end 86 of the rod 84 to provide a recess 87. End 86 of rod serves as a light input region for light entering the rod 84 as will be described hereafter.

The sleeve 81 and rod 84 are then fused together to form a unified structure. As the material of the sleeve 81 and the rod 84 are identical thermal cycling does not result in the generation of thermal stressing.

If necessary the fused or otherwise linked sleeve and rod can be subjected to an annealing treatment to remove internal thermal stresses generated by the production process.

Figure 8D shows the unified structure prior to closure of the recess 87 by heating and closing. Light emitting element 88 and conductors 89, 90 are shown located in the recess 87 with the light emitting element set 1mm, or closer, to end 86 of the rod 84 which serves as a light input region for the rod 84. The outer length X2 of projecting length X of sleeve 81 is then heated and pressed to form a sealed closure through which conductors 89, 90 extend from the the containment C for element 88.

By juxtaposing light emitting element 88 very close to end 86 (the light input region) of rod 84 which serves as the light conducting element of the device the element 88 when energised causes the device to function as a very efficient light utilising and supply means.

Figure 8E shows the completed device D with projecting conductors 89, 90 available for attachment to a power supply. The light emitting element 88 is shown within a plenum 91 which in this case has been evacuated to maintain a vacuum in the vicinity of the element 88.

For use the device D can be used as a discrete item to provide a compact and bright source of light or be coupled to a further light conductor or other light using device by way of end face 85. If required the device can be used in conjunction with a light

conductor which can split to create at least two further light paths or to provide a lateral light projection from the side wall of the light conductor.

The device D has been described in tersm of a circular section sleeve 81 and a rod 84. However elements of other cross sections can be used depending on the required path to be provided for the light . In addition the cross section of the light conducting path can be changed for whatever reason. This the device D can be used as a circular section light source for a light conducting path which changes in cross section to provide an outlet, displsy, end of non-circular shape.

Once the device has been formed the outside of the device, or at least of the containment, can be coated, such as with silver or other reflective medium, to optimise the output of the light emitting element into the light input region of the light conducting element. If necessary the step of forming the containment can provide for the containiment itself, at least in the vicinity of the emitting element, to have a shape which contributes to the effectiveness of light output from the device. Thus with a coating the specially shaped region of the containment can provide an external mirror with the light emitting element at a focal point of the mirror. Altrenatively the specially shaped region can form a lens providing for refraction of light emitted from the emitting element.

In other embodiments of the device the step of locating the light emitting element within the sleeve length X can also include the location of mirror and/or lens elements relative to the light emitting element prior to the forming of the sealed containment.

Any of the light emitting elements mentioned in connection with the embodiments can be used to provide for any wave length or combination of wave lengths of electro magnetic energy. Typically a light emitting element having diffferent regions may be fitted within a given containment. Each region can be energised separately and each region serves to generate a different wavelength light compared to the remaining regions.

The combined device mentioned above may have at any part or parts of its

construction coatings that are so spaced that when a coherent light source of monochromatic light is emitted from the light emitting device. The combined effect being to amplify that emitted light that is then further enhanced by materials chosen for their release of electromagnetic energy, when stimulated by the energy from the light emitting element or elements of the device.

The device may be so shaped that the element is almost touching or slightly spaced from its containment so allowing the light to be collected close to the element but on the outside of the housing by a light conducting element attached to the housing containment and utilising one or more reflectors, to enhance the systems function.

The embodiments shown in Figure 6 and 7 are particularly suited for remote light indication systems. The light conducting elements 63, 73 can be taken directly to a lighting requirement via one or more conduit guiding systems. The devices 60, 70 would be disposable and held in place by a simple retainer The device can be removed from the remainder of the system for servicing or replacement without extensive or indeed any removal of local components such as bulkheads or cosmetic casings or coverings.

Desirable light modification can be achieved at any point in a given device for example, by moving as shown in Figure 4 and 5 one or more of the light conducting elements 43 towards or away from the light emitting element 41 inside the containment housing 44. In this way the output light energy can be made more or less concentrated.

Suitable existing devices and means can be used to provide for light generated by light emitting devices according to the present invention to be changed in scale of illumination, illumination level and in colour.

Devices as mentioned above can require very little energy and can be used to provide miniature lighting for all applications where powerful hands free light is required especially in hobbies such as attachment to diving equipment or fishing equipment as reel or rod illumination or other hobbies or pastimes, industrial or domestic situations. They can be made as disposable and/or sterile and/or reusable

especially in medical and surgical applications.

Miniature versions of the proposed devices can act as lighting or indication systems for miniature electronic assembles or components or act as relays or communication links or activate remote control of equipment or other sub assemblies. Lengths of light guides can be supplied as part of the component, such that service or construction personnel can cut the fibre easily to the required length and insert the output end directly into a holding device or into a conduit as described above.

One or more of these miniature devices emitting infra red or other wave lengths, into an adjacent similar light conducting element can be used to communicate a function or desired effect or message. The receiving fibre being connected in a similar way to a receiving and activation device.

The element for emitting light can include a number of filaments or other light emitters so that the light emitting device can emit at least two different light outputs depending on which filament or light emitting device is energised.

In addition an element for emitting light can be coated to enhance the direction of emission of light by the element.

The exemplary embodiments refer to the use of glass coatings for the light conducting element. However if necesary other coating materials can be used typically metal ones or opaque or translucent ones to vary the light transmissionm characteristics. In addition coating materials can either be formed of or be in good thermal conducting contact with metal or other heat transferring means providing for heat generated by the light emitting element to be conducted away from the device.

Coating of the light conductor will also serve to provide an optimised form of light tranmission along the light conductor.

In many applications heat will be readily dissapated from the device whether by natural or forced convection. In applications where the device is located in a confined space or for some other reason is laible to overheating then a thermal cut out can be

incorporated in the device or in good heat transfer contact with it so that in the event of overheating the power supply to the light emitting element is cut off and the device allowed to cool until the thermal cut off device is enabled to restore the power supply.

In small scale applications systems according to the invention can be incorporated into clothing or articles or where ever general or artistic lighting requirements have a requirement for the characteristics mentioned in this application.

For large lighting situations central lighting can be achieved by large versions of the above device. These large devices can utilise high power light emitting elements such as arcs. These devices can be used to light a whole building or other defined area. The large amount of heat generated by these units can be controlled in a safe maintenance area and incorporated into the heating system of the building, via heat exchangers and other state of the art exchange and control systems. The light is conducted from the light emitting unit, in this case an arc, via light conducting elements as described above. The containment for the arc and/or the light conducting element incorporate fins or other means to provide for efficient heat transfer from the containment and/or the light conducting element to a coolant circuit utilising gas or liquid coolant displaced by way of a natural or forced convention coolant circuit. Such units can be used to provide cold light for illumination but also to provide a substantial heat supply such as can be utilised to maintain or top up a heat supply for, say, an air conditioning unit. A typical use for such an installation would be in a store or supermarket where the arc system provides for general and sign illumination and the heat generated by the arc system can be used to provide for background air or water heating and/or air conditioning. Such a system can also be incorporated into day light collection systems as enhancement or back up with the energy being converted to heating water when the sunlight provides enough electricity for total lighting requirements but can reverse instantaneously should the sun be obscured such as by cloud.

The above devices can be used in any situation where remote and/or efficient light or heat energy is required for communication or inspection or control or heating or educational or any other application. For example a small device directly connected

to a flexible or other light guide can be kept on an enclosed or open reel which is then pulled out and used as an inspection light the device being on a reel which is sprung loaded so that when a retainer is released the light guide springs back into its case.

Either end of the light conducting device can be shaped as a lens or coated or modified to enhance function by any state of the art -process or light modification technique for example polarisation of the transmitted light.

All or part of a light conducting element can be an amorphous light conducting material such that when pressure is applied to the external part of the light conducting element the shape of its end or other part is altered rather like a remote controlled amorphous lens.

A particular application for the present invention would be for endoscope for internal inspection of human or animal bodies where the miniaturising possibilities of the present invention serve to provide for advantageous designs.

The present invention provides for light outputting device and systems which can be utilised in a wide range of applications including:
commercial and residential locations,
medical and surgical sites;
illumination of simple or elaborate displays, representations at point of sale devices;
and control system displays varying from the simple to the very elaborate;
signalling systems.

The invention also envisages an array made up of at least two light emitting devices each being linked by a light guide array linking the or, at least one light conducting element of a device, to a light output location remote from at least one device. Typically the array can, where necessary, be cooled by natural convection. Alternatively heat exchange elements incorporated in the device or the light guide array or both can be subject to natural or forced convection flows of air, liquid or a mixture. As an example a large scale installation using powerful light and heat emitting elements can provide for efficient illumination and heating (with or without

at least a partial contribution to air conditioning) of a shopping, catering, medical, commercial or manufacturing location.

By incorporating suitable devices the invention can provide not only for fixed levels on illumination with any practical degree of definition but also for changes in light levels and colour. By incorprating mirros and lenses within the enclosure it is possible for such devices to be small, accurately aligned and virtually incapable of being damaged by anything except virtual destruction of the device.

A device accoridng to the present invention can be used for a range of applications where both light and heat are required to take advantage of inherent strength of a unit (for example of the type described in connection with Figure 8). By providing a small bore in the light conducting member the device can be used as a pre-heater for a fuel supply.

Because of its inherent strength at least in small scale versions and its ability to operate at low voltages a device according to the preent invention can be used in situations where safety is of paramount importance. In a decorative context low powered devices can be used in locations subject to crowding such as pubs, restaurants or transport such that in the event of damage, whether malicious or accidental will merely result in the loss of decorative illumination without exposure of conductors bearing life endangering voltages or currents.

The following listing exemplifies the wide range of applications to which the present invention lends itself.

Electronic instrumentation where the light emitting elements for the device include single or multiple light emitting diodes, near infra-red emitter, single or multiple white lights.

Possible applications include

Power usage consumption	*Brightness*	*Applications*
Low	Bright devices	Mass prodution cheap devices for hobbies, inspection, medical, dental.
Higher	High brightness	Miners head lamps, surgical, bicycle lighting, industrial inspection
Low	Bright	Particularly in minaturised versions: Diving, surgical, mining, video and digital camers, automotive.
High/Low voltage	Special high brightness, high colour temperature	Aircraft, automotive, marine, industrial.
High/low voltage	Very high brightness	Domestic light bulb replacement. Mini light bulb replacement.
High	Multi element, gas or cooled, centralised lighting system	Vandal proof lighting, energy efficient, Liquid low maintenance, 'cold' light, safe light for hazardous environment, water heating or topping up in public utility uses, fire detection, security systems, hospitals, offices, retail, industrial, catering, hotels, large domestic. Air conditioning.

CLAIMS

1 A light outputting device comprising:

a containment for housing an element for emitting light;

a light conducting element aligned relative to the containment by means of the containment or an extension thereof the light conducting element having a light input region such as an end face of the light conducting element; and

a light output region of the containment adapted for alignment with the light conducting element so that light generated by the emitting element is caused to pass by way of the light output region into the light input region.

2 A light outputting device as claimed in Claim 1 wherein the containment or an extension thereof serves to locate the light output region of the containment with the light input region of the conducting element such that the light input region is closer to the element for emitting light than the major part of the containment.

3 A light outputting device as claimed in Claim 1 or Claim 2 wherein the containment serves to provide a location means for the device adapted for complementary engagement with an external device whereby the device can be demountably attached by means of the light conducting element or an extension thereof to a further light conducting path in a predetermined position relative to some path datum.

4 A light outputting device as claimed in any preceding claim incorporating a reflector located relative to the element for emitting light and the, or at least one, light conducting element so as to reflect light from the element for emitting light by way of the light output region into the light input region of the light conducting element.

5 A light outputting device as claimed in any preceding claim incorporating a refractor located relative to the element for emitting light and the, or at least

one, light conducting element so as to refract light from the element for emitting light into the light input region of the conducting element.

6 A light outputting device as claimed in any preceding claim wherein the containment is substantially opaque except for the light output region and light can only pass out of the containment by way of the light output region to the, or at least one, light conducting element.

7 A light outputting device as claimed in any preceding claim incorporating heat transfer means such as a heat sink in intimate contact with, or forming an integral part of, the containment whereby heat generated by the element for emitting light can be dissipated.

8 A light outputting device as claimed in any preceding claim incorporating heat transfer means such as a heat sink in intimate contact with, or forming an integral part of the, or at least one, light conducting element whereby heat generated by the element for emitting light can be dissipated.

9 A light outputting device as claimed in any preceding claim wherein the containment serves to define a plenum about the element for emitting light so as to maintain in the plenum a vacuum about the element for emitting light.

10 A light outputting device as claimed in any of preceding claims 1 to 8 wherein the containment serves to define a plenum about the element for emitting light so as to maintain in the plenum an inert gas or a mixture of gases about the element for emitting light.

11 A light outputting device as claimed in any preceding claim incorporating means for varying the colour of light output by the device.

12 A light outputting device as claimed in any preceding claim wherein the element for emitting light comprises more than one light emitter so that the element for emtting light can be used to emit more than one light wavelength.

13 A light outputting device as claimed in any preceding claim wherein the light conducting device is at least in part shrouded by a close fitting opaque sleeve.

14 A light outputting device as hereinbefore described with reference to and as illustrated in Figure 1, or Figure 2, or Figure 3, or Figures 4 and 5, or Figure 6 or Figure 7 of the accompanying drawings.

15 A method of fabricating a light outputting device as claimed in preceding claims 1 to 13 characterised by the steps of:

providing the light conducting element in the form of a longitudinal member with end faces and an outer surface apart from the end faces;

locating around the light conducting element a sleeve member of greater length than the light conducting element with a first end of the light conducting element at or near one end of the sleeve so as to leave a length of sleeve projecting beyond the opposite end of the light conducting element to the first end;

the opposite end of the light conducting element to the first end forming, at least in part, the light input region;

causing the sleeve member to be contiguously juxtaposed with the outer surface of the light conducting element;

locating the element for emitting light in the length of sleeve projecting beyond the opposite end;

deforming the length of sleeve so as to form together with the light input region of the light conducting element the containment for the element for emitting light; and

sealing the deformed length of tube to cause the containment to form a a gas tight enclosure for the element for emitting light.

16 A method of fabricating a light outputting device as claimed in Claim 15 wherein the sleeve is of a similar material to the light conducting member and the step of causing the sleeve member to be contiguously juxtaposed with the outer surface of the light conducting element comprises a fusing operation.

17 A method of manufacturing a light outputting device as claimed in Claim 15

wherein the sleeve is of a translucent or opaque material having a thermal coefficient of expansion comprable with that of the light conducting member.

18 A method of manufacturing a light outputting device as claimed in Claim 15, 16 or 17 wherein the step of locating the element for emitting light in the length of sleeve projecting beyond the opposite end includes locating conductors for supplying energy to the element.

19 A method of manufacturing a light outputting device as claimed in Claim 15, 16, 17 or 18 wherein the step of locating the element for emitting light in the length of sleeve projecting beyond the opposite end includes locating a mirror element for reflecting light generated by the element for emitting light to enable the mirror element to be enclosed with the element for emitting light in the containment prior to the deforming and sealing steps.

20 A method of manufacturing a light outputting device as claimed in any of preceding claims 15 to 19 wherein the step of locating the element for emitting light in the length of sleeve projecting beyond the opposite end includes locating a lens element for refracting light generated by the element for emitting light to enable the lens element to be enclosed with the element for emitting light in the containment prior to the deforming and sealing steps.

21 A method of manufacturing a light outputting device as hereinbefore described with reference to the accompanying drawings.

22 An array comprising at least two devices, as claimed in any of preceding claims 1 to 14 or fabricated by means of a method as claimed in Claims 15 to 21 and a light guide array linking the or at least one light conducting element to a light output location remote from at least one device.

23 An array as claimed in Claim 22 wherein at least one of the devices is coupled to a heat exchange means whereby heat generated by the or each device is dissipated such as by natural or forced convection utilising gas or liquid coolant.

24 An array as claimed in Claim 22 or 23 incorporating in the light guide array or the light output location means for varying the colour of light originating from at least one of the devices.

25 An array as claimed in Claim 22 wherein at least one of the devices is demountably attached to the array and a magazine of replacement devices is located for the demountably attached device to enable the demountably attached device to be readily removed and replaced by a replacement device from the magazine thereof.

26 An array comprising at least two devicesa as hereinbefore described.

ABSTRACT

LIGHT EMITTING DEVICES AND ARRAYS THEREOF.

A light outputting device comprises: a containment for housing an element for emitting light; a light conducting element aligned relative to the containment by means of the containment or an extension thereof the light conducting element having a light input region such as an end face of the light conducting element; and a light output region of the containment adapted for alignment with the light conducting element so that light generated by the emitting element is caused to pass by way of the light output region into the light input region. Typically the containment or an extension thereof serves to locate the light output region of the containment with the light input region of the conducting element such that the light input region is closer to the element for emitting light than the major part of the containment.

A method of fabricating a light outputting is characterised by the steps of: providing the light conducting element in the form of a longitudinal member with end faces and an outer surface apart from the end faces; locating around the light conducting element a sleeve member of greater length than the light conducting element with a first end of the light conducting element at or near one end of the sleeve so as to leave a length of sleeve projecting beyond the opposite end of the light conducting element to the first end; the opposite end of the light conducting element to the first end forming, at least in part, the light input region; causing the sleeve member to be contiguously juxtaposed with the outer surface of the light conducting element; locating the element for emitting light in the length of sleeve projecting beyond the opposite end; deforming the length of sleeve so as to form together with the light input region of the light conducting element the containment for the element for emitting light; and sealing the deformed length of tube to cause the containment to form a a gas tight enclosure for the element for emitting light. Typically the sleeve is of a similar material to the light conducting member and the step of causing the sleeve member to be contiguously juxtaposed with the outer surface of the light conducting element comprises a fusing operation.

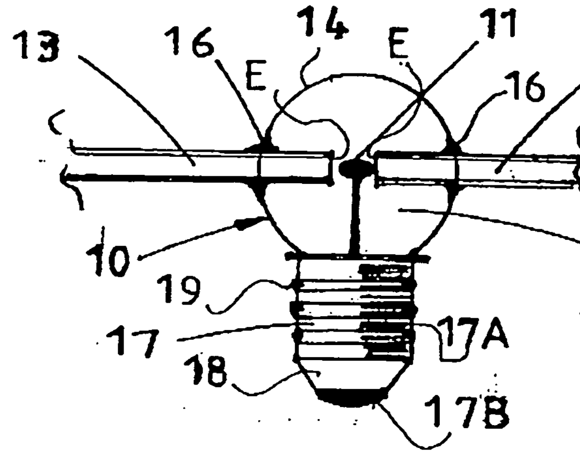
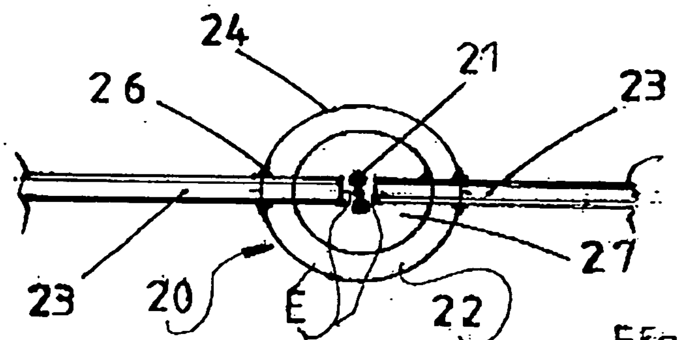


Fig1



Ffg 2

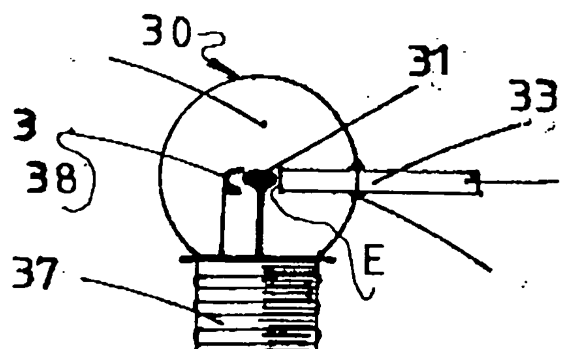


Fig 3

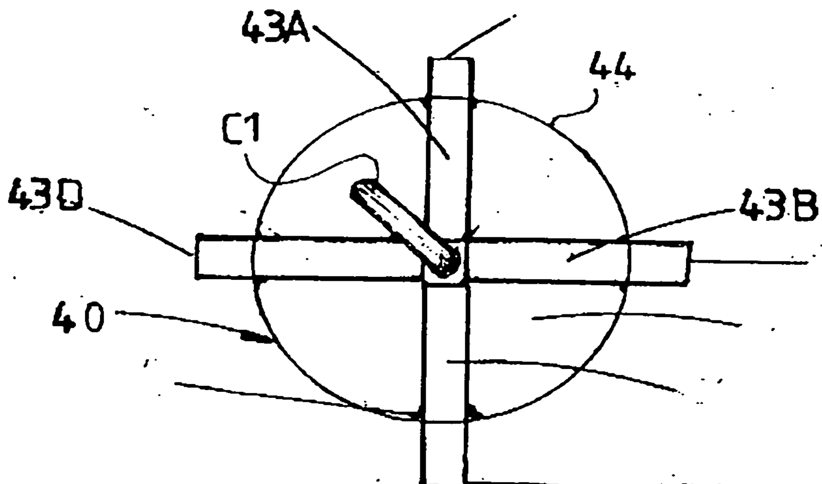


Fig 4

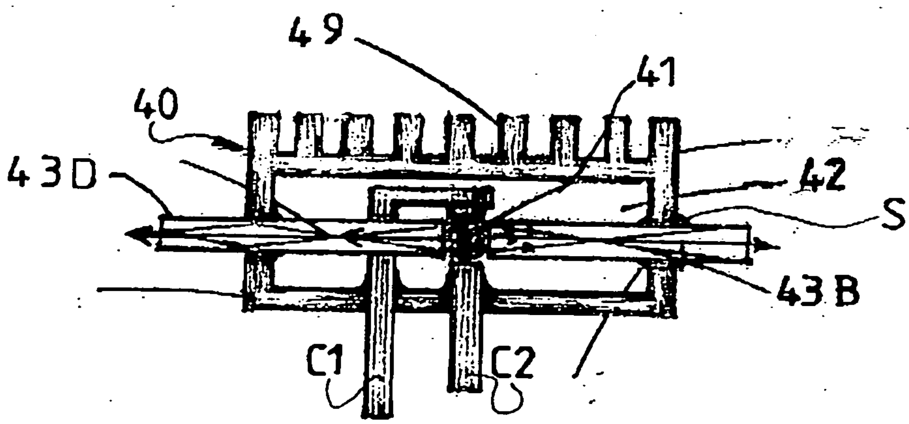


Fig 5

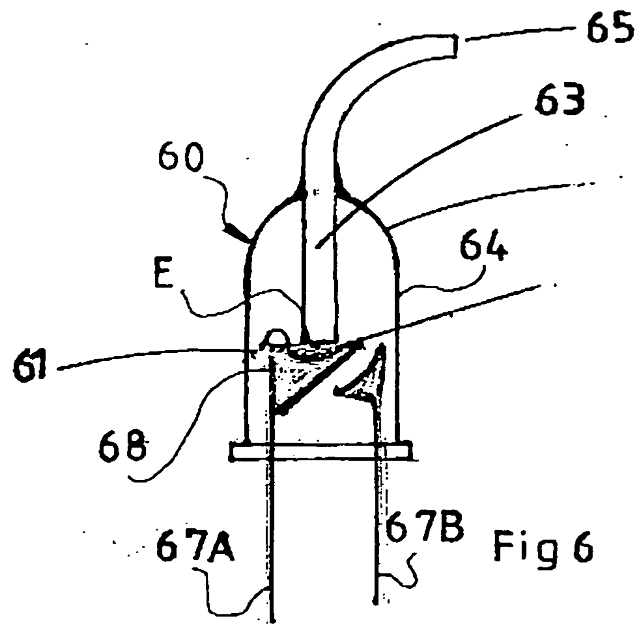


Fig 6

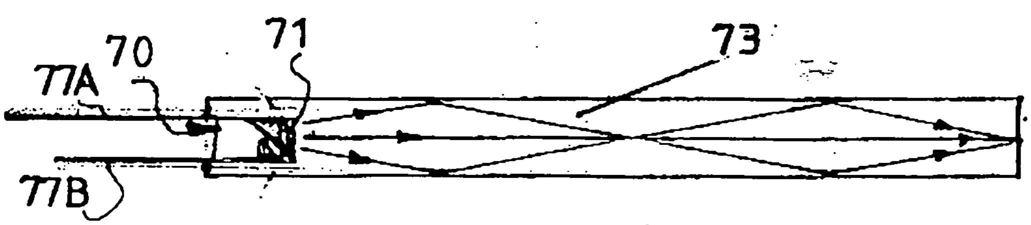


Fig 7

Fig 8A

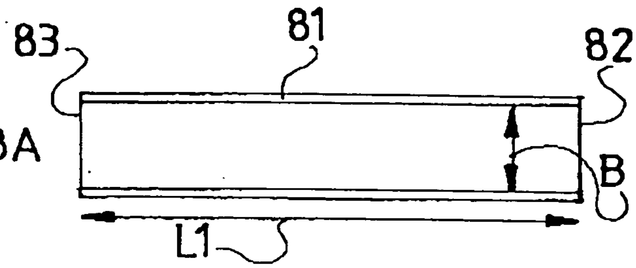


Fig 8B

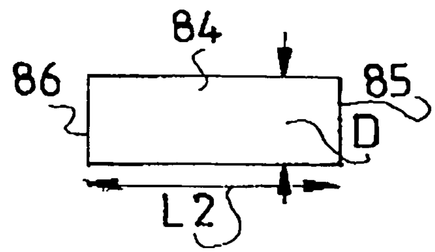


Fig 8C

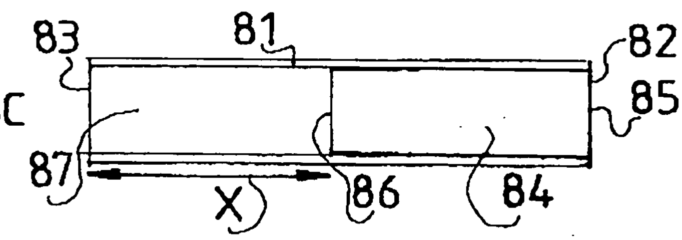


Fig 8D

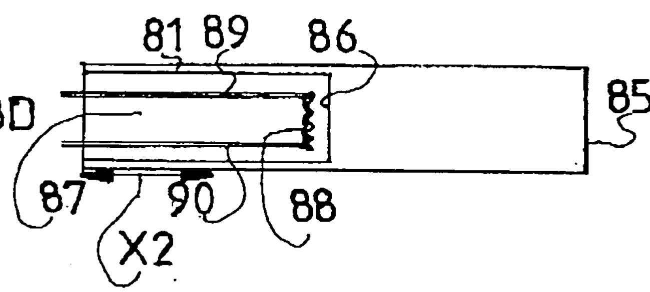


Fig8E